Space Weather Technical Forecast

Issued on Monday, 08 July 2024 at 13:19 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: Further M-class flares likely.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Moderate with multiple low level M-flares in the past 24hrs, the largest an M2.4 flare coming from just over the southeast limb, peaking at 07/2230 UTC.

There are seven sunspot regions on the disc. AR3738 in the southeast remains the largest and most complex region and has shown some overall growth in recent hours, despite having lost its small delta spot. AR3733 in the northwest is now the second largest region, but is becoming harder to assess as it rotates out of view around the western limb. AR3740 has developed a small delta region in its rearward spot in recent hours. Magnetic looping evident over the southeastern limb suggest new regions will rotate onto the visible disc in the coming days. All other groups appear small and simple at present.

No Earth-directed Coronal Mass Ejections (CMEs) have been observed during the past 24 hours.

Solar Wind / Geomagnetic Activity: Solar winds as observed by ACE at L1 peaked at slightly elevated levels of 417 km/s at 08/0014 UTC possibly as a result of a weak connection to CH49/+ in the northwest. Since then, solar winds have been on a slow decline back to current levels of around 380 km/s. The density was mostly below average, but has risen in recent hours to average levels of around 8ppcc. The Interplanetary Magnetic Field, Bt, was largely weak, staying at or below 8 nT, however it has also risen in recent hours to moderate levels of around 11nT. The north-south component, Bz, varied weakly between +6/-8 nT. The phi angle was predominately positive (away from the Sun).

The resulting geomagnetic activity was Quiet to Unsettled (Kp1-3).

Energetic Particles / Solar Radiation: The high energy (greater than 10 MeV) proton flux observed by GOES18 remained at background levels. High energy electron flux (greater than 2MeV) observed by GOES16 remained at background levels. The 24-hour fluence was below Active, with 2.15e6 integrated pfu observed at 08/0000UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: There is a likelihood of further M-class flares, with a slight chance of X-flares, most likely from AR3738 or from new regions that rotate over the southeastern limb in the coming days.

Solar Wind / Geomagnetic Activity: No Earth-directed CMEs feature in the forecast. The solar wind is most likely to be at slow-ambient levels for much of this period. A small coronal hole in the north may give some minor enhancements on Day 1 (08 Jul). Coronal hole CH51/-, currently near south centre disc, could produce slightly elevated to elevated wind speeds later in the period, perhaps on Days 3-4 (10-11 Jul). However, any significant geomagnetic response from either of these two coronal holes is likely to be muted due to Earth's proximity to the solstice.

Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp0-3) through the next four

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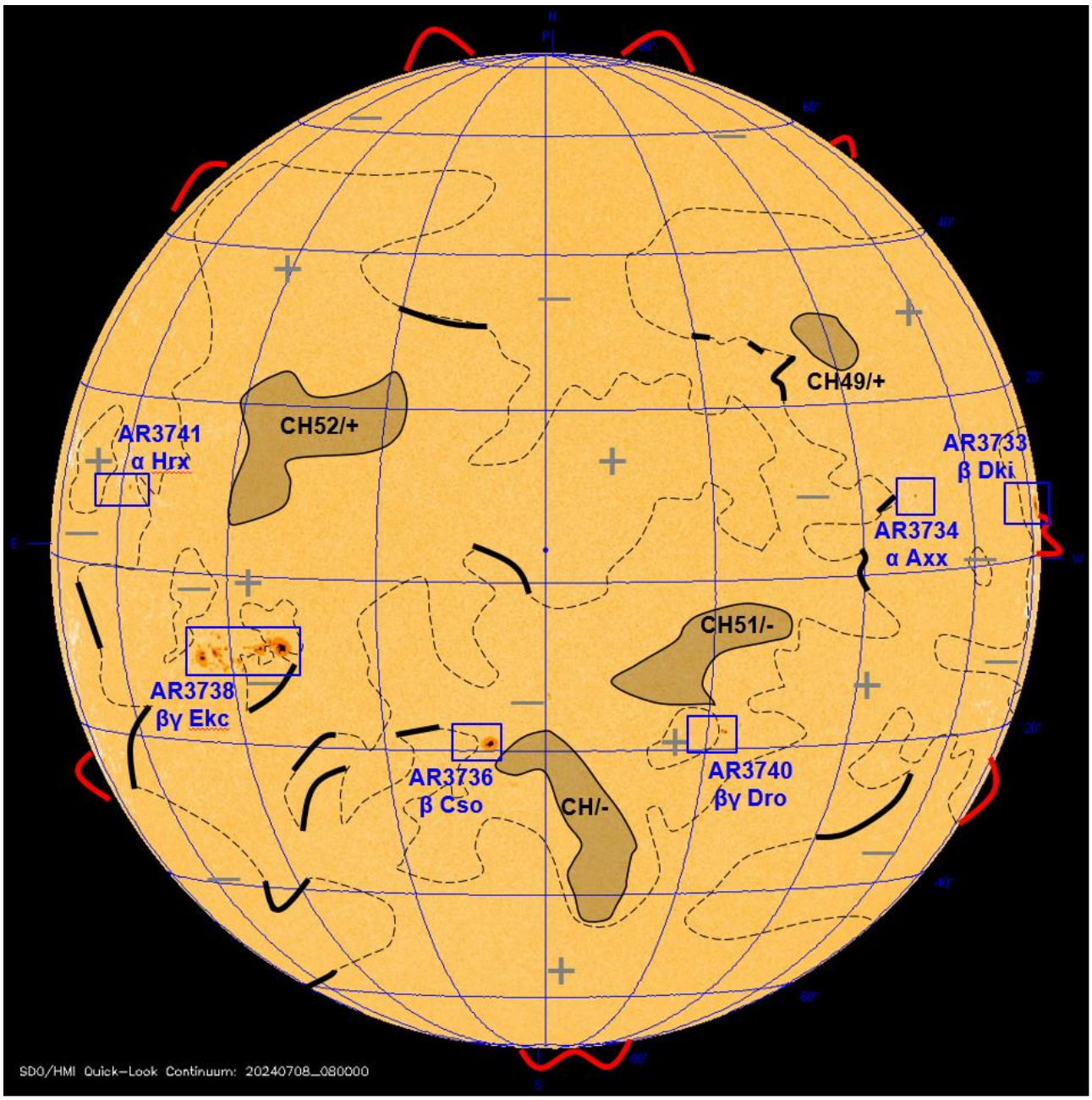
days, however there is a chance of isolated Active (Kp4) intervals, most likely on Days 3-4 (10-11 Jul), due to potential fast wind influence.

Energetic Particles / Solar Radiation: Solar radiation storms are unlikely, but with a slight chance of reaching S1/Minor Radiation Storm or greater levels. This risk increases a little later in the period as AR3738, currently in the southeast, rotates towards centre disc and into a more geoeffective position.

High energy electron flux is expected to remain mostly at background levels through this period, with the Active (1e8 integrated pfu) fluence threshold not expected to be reached.

Figure 1. Solar Analysis Valid 08/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

No Earth-directed CMEs feature in the forecast.

In the expected absence of any CME arrivals, the solar wind is most likely to be at slow-ambient levels for much of this period. However, there are a couple of coronal holes that could be in play. Solar wind speeds have recently been on the decline from slightly elevated levels, perhaps as a response to a connection to a small positive coronal hole in the northwest quadrant. This coronal hole (CH49/+) has become obscured by flux to the point it is barely visible, however could help keep winds close to slightly elevated levels on Day 1 (08 Jul).

A second larger coronal hole near centre disc in the south (CH51/-) could produce slightly elevated to elevated wind speeds later in the period, perhaps on Days 3-4 (10-11 Jul). This is a larger coronal hole than the previous rotation when there was no influence from this feature, closer to the solar equator, so it could bring fast winds this time around.

Any significant geomagnetic response is unlikely from either of these two coronal holes due to Earth's proximity to the solstice.

Geomagnetic activity is expected to be mostly Quiet to Unsettled (Kp0-3) through the next four days, however there is a chance of the odd Active (Kp4) interval, most likely on Days 3-4, due to potential fast wind influence.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	1	1	5	5
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

No Earth directed CMEs expected.

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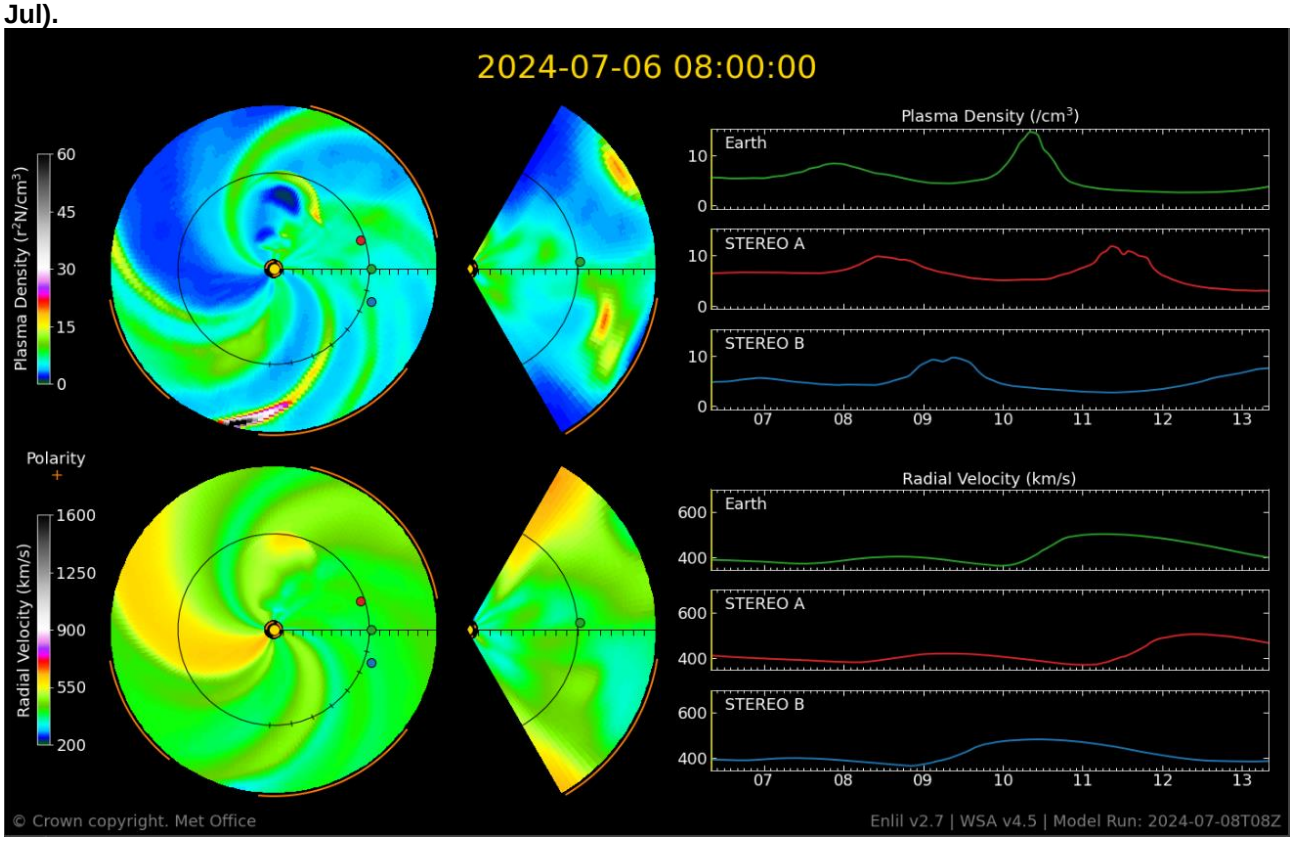
Figure 2: MOSWOC Enlil showing possible influence from a coronal hole fast wind on Days 3-4 (10-11 Jul).



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Radio Blackouts - X-Ray Flares:

Solar activity has been Moderate with a number of M-class flares, all from a region over the southeastern limb. SDO imagery shows a considerable amount of magnetic looping above the Sun's surface in this location. A long period flare peaked at M2.4 at 07/2230 UTC, the largest of the past 24hrs.

There are seven sunspot regions on the disc. AR3738 (Ekc/Beta-Gamma) in the southeast remains the largest and most complex region and has shown some overall growth in recent hours, despite having lost its small delta spot. AR3733 (Dki/Beta) in the northwest is now the second largest region, but is becoming harder to assess as it rotates out of view around the western limb. AR3740 (Dro/beta-delta) has developed a small delta region in its rearward spot in recent hours. Magnetic looping evident over the southeastern limb suggest new regions will rotate onto the visible disc in the coming days. All other groups appear small and simple at present.

Magnetic looping evident in imagery over the southeastern limb, as well as far-side seismographs, suggest more regions are likely to rotate onto the visible disc in the coming days. This will help to offset the loss of AR3729 and AR3733, with a flat flare risk through the period. The main flare risk is from AR3738 and from any new regions that appear around the southeastern limb, with further M-flares likely and a slight chance of isolated X-flares.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	70	70	70	70
Very Active	R3 to R5 X Class	No	10	10	10	10

Figure 3: GOES-16 & GOES-18 X-ray flux

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Solar Radiation Storms - (High Energy Protons):

High energy proton flux at GOES18 has been at background levels. It is most likely to remain that way, but with a slight chance of exceeding the S1/Minor radiation storm threshold, should any larger flares occur from the west of the disc. One of the main risks of larger flaring is from AR3738 in the southeast, and as this region rotates more towards centre disc by Day 3 (10 Jul) onwards, the probability of exceeding S1 increases a little.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	5	5	10	10
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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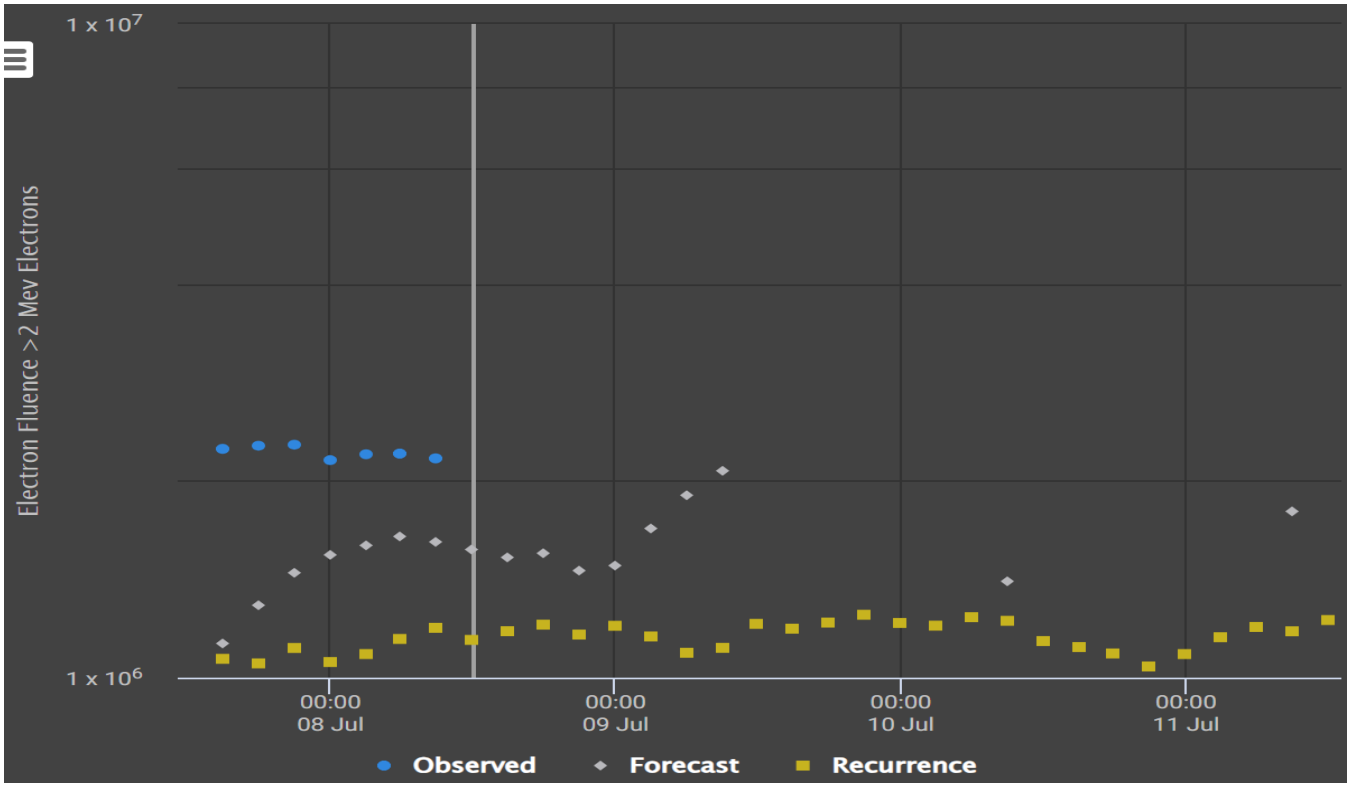
High Energy Electrons Event (≥ 2MeV):

High energy electron flux recorded at GOES16 has been at background levels and is likely to remain that way through the coming four days. A possible fast wind from CH51/- is not expected until Days 3-4 (10-11 Jul), with a response to this feature possible towards the end of this four day period.

The MOSWOC REFM output is considered good guidance, with a generally flat trend indicated through the period.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	1	5
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 4: MOSWOC REM



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